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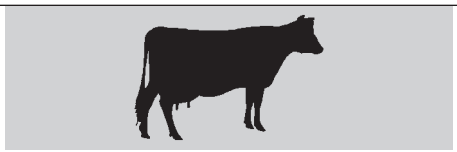

Activated carbon supplementation of dairy cow diets: Effects on apparent total-tract nutrient digestibility and taste preference[1]

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ABSTRACT

The objectives of these studies were to determine whether the adverse effects of feeding poor-quality forages could be alleviated by adding activated carbon as a feed additive through observing the effect of activated carbon on apparent nutrient digestibility and taste preferences. In Exp. 1, 6 multiparous, late-lactation Holstein cows were assigned to a replicated 3 × 3 Latin square. All cows were fed a basal diet containing approximately 60% poor-quality corn silage containing the mycotoxin deoxynivalenol. The 3 treatments were 0, 20, or 40 g of activated carbon top-dressed once daily at the p.m. feeding. Cows fed activated carbon had increased DMI and apparent total-tract nutrient digestibilities of NDF, hemicellulose, and CP. Cows fed activated carbon also had increased milk fat content and showed increased BCS. In Exp. 2, 3 cannulated, primiparous, early-lactation Holstein cows were used in a 3 × 3 Latin square design. The cows were fed 0, 20, or 40 g of activated carbon per day using good-quality forage, which resulted in no differences in apparent total-tract nutrient digestibility or milk composition and yield. In Exp. 3, 6 early-lactation, primiparous Holstein cows were assigned to a sequential elimination trial with access to 0, 10, 20, 40, or 80 g/d of activated carbon in a cafeteria-style feeder to determine taste preference. Cows were fed a diet similar to that in Exp. 2. As activated carbon increased, preference for that particular feed decreased. Results indicated that activated carbon improves apparent total-tract nutrient digestibilities when cows are fed poor-quality (mycotoxin-laden) silage, but activated carbon should not be used when good-quality forage is fed.

Key words: activated carbon, dairy cow, nutrient digestibility, taste preference

INTRODUCTION

Field reports indicate that more than 20% of Vermont dairy farms experience at least one bout of mycotoxin contamination of feed annually (Gotleib, 1999). It is reasonable to assume that other northeastern states have similar rates of contamination. Mycotoxins are toxic secondary metabolites of fungi and are universal contaminants of food and feed (Coulombe, 1993). Contamination of silage with mycotoxin occurs when forages are incorrectly ensiled, or it can develop in the field before harvest (Seglar, 1999). In cases of mycotoxin contamination originating from mold development in the field, off-colored, moldy forage may not be observed.

Dairy producers feeding mycotoxin-contaminated feeds have experienced a 2 to 10% decrease in milk production (Gotleib, 1999), depressed feed intake, poor reproductive performance, and false-positive antibiotic residues in bulk tank milk. If dairy producers observe moldy silages, the ideal recommendation is to not feed the forage; however, this is often impractical. Producers can consider diluting the contaminated forage with other forages to decrease the dietary concentration of mycotoxins. Many field nutritionists recommend feeding supplements that bind the mycotoxin.

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Table 1. Ingredient and nutrient composition of the diet fed in Exp. 1

Item	% of DM
Ingredients	
Corn silage	59.9
Ground corn	30.0
Soybean meal	6.0
Vitamin and mineral mix[1]	3.6
Sodium bicarbonate	0.5
Nutrients	
NDF	33.2
ADF	21.4
CP	13.3
Ca	0.9
P	0.5

[1]Contained 15% Ca, 4.83% P, 4.84% Mg, 9.70% Na, 14.60% Cl, 2.19% S, 9.82 mg/kg Se, 2,500 mg/kg Zn, 141,200 IU vitamin A/kg, 47,400 IU vitamin D/kg, and 1,230 IU vitamin E/kg.

Activated carbon (**AC**), routinely used as a water purifier, has been used as a toxin binder in other applications; however, it has not been approved as a feed ingredient in the United States. Early research indicated that feeding AC at high doses (≥500 g) to cattle fed pesticide or pesticide-contaminated feed reduced the accumulation of the pesticide in fat (Wilson et al., 1971) and reduced the effectiveness of an oral insecticide (Rumsey et al., 1975). However, when rats and cows were fed pesticide-contaminated feed and supplemented with AC after being fed the contaminated feed, no change in adipose pesticide concentration was observed (Fries et al., 1970), suggesting that AC must be supplemented with the contaminated feed for it to be effective. There are limited studies evaluating AC with mycotoxin-contaminated forage or noncontaminated forage and its effects on digestibility and taste preference. Therefore, the objectives of this experiment were to determine the effects of AC on diet digestibility and taste preference of diets containing AC.

MATERIALS AND METHODS

Exp. 1

Six late-lactation (>200 DIM) Holstein cows (738 kg of BW) were assigned to a replicated 3 × 3 Latin square experiment. The protocol was approved by the University of New Hampshire Institutional Animal Care and Use Committee. Cows were housed in a naturally ventilated tie-stall barn, were bedded with kiln-dried sawdust with individual mangers, and shared water bowls. Cows were fed a single diet (Table 1) with 0, 20, or 40 g of AC (Darco S-51, pore size = 150 μm, Norit Americas Inc., Atlanta, GA) hand mixed into the diet during the p.m. feeding. Cows were fed a TMR twice daily (0400 and 1400 h) to provide 10% orts, which were removed just before the p.m. feeding.

Experimental periods lasted 21 d, with the first 11 d for diet adaptation. Cows were dosed with 10 g of Cr_2O_3 in a gelatin capsule twice daily at 0430 and 1630 h via balling gun beginning on d 11. Feeds were sampled daily on d 15 to 19, and feed refusals were sampled on d 16 to 20. Rectal fecal grab samples were taken at 12-h intervals from d 16 to 21, staggered at 2-h intervals such that a sample was taken every 2 h in a 24-h period.

Feed and orts were composited for each period based on amounts of feed intake and amounts of orts. Fecal samples (100 g) were composited and frozen as collected. Composited samples (feeds, orts, and feces) were oven dried at 60°C (12 h for feed and orts and 48–72 h for feces; VWR Scientific, West Chester, PA) and ground through a 1-mm screen using a Wiley Mill (Thomas Scientific, Swedesboro, NJ). Dried-and-ground samples were analyzed for N, NDF, and ADF at Analab Inc. (Fulton, IL). Hemicellulose concentrations were determined as the difference between NDF and ADF concentrations. Fecal samples were analyzed for Cr by atomic absorption (Williams et al., 1962). During each period, samples of corn silage were taken randomly over the silage pile and from the face of the pile for determination of deoxynivalenol (**DON**) according to the method of Trucksess et al. (1996). Deoxynivalenol concentration was determined because it is routinely used as an indicator of the presence of mycotoxins in forage (Gotleib, 1999; Whitlow and Hagler, 1999a). Volatile fatty acids were assayed according to Cancalon (1993). Colony forming units (cfu) per gram of yeasts and molds in corn silage were counted after incubation on potato dextrose agar with 1.4% tartaric acid added and growth for 96 h at 25°C. Milk weights were obtained at each milking on d 11 to 21 of each experimental period. Milk samples (a.m. and p.m.) were taken on d 16 to 21 and analyzed for true protein, milk fat, and milk urea N (Dairy One, Ithaca, NY). Cows were weighed weekly on a digital scale (Geo Research Inc., Billings, MT), and BCS (Edmonson et al., 1989) were determined by 3 individuals during each treatment period.

Exp. 2

Three early-lactation (30 DIM), primiparous, rumen-cannulated Holstein cows (501 kg) were assigned to a 3 × 3 Latin square experiment. The cows were housed in tie-stalls and remained with the milking herd, with individual mangers, shared water bowls, and were bedded with kiln-dried sawdust. Cows were fed feeds similar to those fed to the rest of the herd. The experimental periods were the same as in Exp. 1. This protocol was approved by the University of New Hampshire Institutional Animal Care and Use Committee. Cows were fed a TMR (Table 2) 3 times daily (0500, 1400, and 2200 h). The treatments were the same as in Exp. 1 (0, 20, or 40 g of AC/d); however, in this study the dose was split into 2 doses, with cows receiving AC at 0730 and 1930 h via the rumen cannula. The AC was placed into gelatin capsules to allow for easy dosing into the rumen through the cannula. Cows received 10 g of Cr_2O_3 in gelatin capsules at 1030 and 2230 h via balling gun